Sudden Infant Death and Social Justice: A Syndemics Approach

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Abstract:

Sudden Unexpected Infant Death (SUID) and Sudden Infant Death Syndrome (SIDS) prevention has focused on modifying individual behavioral risk factors, especially bedsharing. Yet, these deaths are most common among poor and marginalized people in wealthy countries, including US Blacks, American Indians/Alaskan Natives, New Zealand Māori, Australian Aborigines, indigenous Canadians, and low-income British. The US now has the world's highest prevalence of SUID/SIDS, where even whites' SIDS prevalence now approaches that of the Māori. Using public databases and the literature, we examine SUID/SIDS prevalence and the following risk factors in selected world populations: maternal smoking, preterm birth, alcohol use, poor prenatal care, sleep position, bedsharing, and formula feeding. Our findings suggest that risk factors cluster in high-prevalence populations, many are linked to poverty and discrimination, and have independent effects on perinatal outcomes. Moreover, populations with the world's lowest rates of SUID/SIDS have low income-inequality or high relative wealth, yet have high to moderate rates of bedsharing. Employing syndemics theory, we suggest that disproportionately high prevalence of SUID/SIDS is primarily the result of socially-driven, co-occurring epidemics that may act synergistically to amplify risk. SUID must be examined through the lens of structural inequity and the legacy of historical trauma. Emphasis on bedsharing may divert attention from risk-reduction from structural interventions, breastfeeding, prenatal care, and tobacco cessation. Medical organizations play an important role in advocating for policies that address the root causes of infant mortality via poverty and discrimination interventions, tobacco control, and culturally appropriate support to families.

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Introduction: Approaches to prevention of Sudden Unexpected Infant Death (SUID) and Sudden Infant Death Syndrome (SIDS) have historically emphasized individual behavior change, most often focusing on bedsharing. Often overlooked in discussions about SUID however, is that these deaths primarily occur among poor and marginalized people in wealthy countries. Compared to rates of SUID/SIDS in their general populations, markedly elevated rates have been found in US Blacks, American Indians and Alaskan Natives, New Zealand Māori, Australian Aborigines, indigenous Canadians, and low income British people. In this paper we draw on anthropological and social epidemiological insights to argue that instead of this individualistic approach, we need to consider the social origins, clustering or co-occurrence and interplay of known risk factors (Ball et al., 2016; Singer, Bulled, Ostrach, & Mendenhall, 2017) in order to make progress in reducing infant deaths in high-risk populations.

Definitions**:** SUID historically encompasses the following ICD-10 codes: SIDS (R95), Ill-defined and Unspecified Causes of Mortality (R99), and Accidental Suffocation and Strangulation in Bed (ASSB, W75). Overall, SIDS and SUID rates have fallen dramatically between 2002 and 2012 and beyond in many countries, with the US being a notable exception (B. J. Taylor et al., 2015).

Bedsharing and Co-sleeping**:** We define co-sleeping as whenever mother and infant are sleeping within physical contact of one another. In this paper the word co-sleeping may encompass bedsharing, but we will use bedsharing to specifically mean a mother sharing an adult bed with her infant**.**

Physiologic basis for infant deaths associated with known risk factors**.** Below we briefly review the physiologic mechanisms by which smoking, prone sleep, formula feeding, preterm birth, and soft bedding such as sofas increase risk of death, independent of any sociological context, eg poverty.

Smoking, both antenatal and post-natal, is thought to provide a physiologic basis for death due to effect on serotonin (Duncan et al., 2009; Kinney, 2009), which affects arousal, recovery from hypoxia and hypercapnia and thermoregulation. There is strong evidence of a dose dependent effect of smoking and SIDS in combination with bedsharing, particularly in maternal post-natal smoking (Zhang & Wang, 2013). Prenatal smoking is associated with deficient hypoxia awakening responses (Lewis & Bosque, 1995) and attenuated recovery from hypoxemic challenges (Schneider, Mitchell, Singhal, Kirk, & Hasan, 2008). Antenatal smoking also increases the risk of preterm birth (Ion & Bernal, 2015), itself a risk for SUID.

Prone sleep position is associated with higher risk of death due to decreased arousability and possibly due to heat stress, as the face is important for dissipation of heat in infants (Kinney & Thach, 2009).

Preterm infants have a higher risk of SUID and SIDS inversely proportional to gestational age (Ostfeld, Schwartz-Soicher, Reichman, Teitler, & Hegyi, 2017). In addition to possible physiologic factors, preterm infants are more likely to bedshare and

to be placed prone to sleep (Colson et al., 2013; Hwang et al., 2015). Why preterm birth increases risk of SUID is poorly understood, and it is possible that the same risk factors that are responsible for the preterm birth may also be responsible for the increase risk of SUID/SIDS, such as smoking. Hypotheses include hypoxia related to immature lung function and lung and airway damage from mechanical or non-invasive ventilation (Garcia, Koschnitzky, & Ramirez, 2013). Apnea of prematurity is not thought to be a factor (Ostfeld et al., 2017).

Soft bedding and sofas provide a risk of death due to asphyxiation (Blair et al., 2009). Alcohol or drug use may increase risk of asphyxiation by overlying as well as by falling asleep in hazardous bedding circumstances such as sofas (Blair, Sidebotham, Pease, & Fleming, 2014). Formula feeding is associated with an increased risk of SIDS (Vennemann et al., 2009), likely due to decreased maternal and infant arousals with decreased synchronization of mother-infant sleep (Mosko, Richard, & McKenna, 1997). Breastfeeding beyond 2 months is associated with a lower risk of SIDS in a dose dependent fashion (Thompson et al., 2017). Videographic data shows bedsharing positions in formula feeding dyads which are more likely to be hazardous (Ball, 2006), although other data shows no increased risk of death from bedsharing and formula feeding if no other risks are present (Blair et al., 2014).

The complex contextual role of bedsharing – potential risks and protective effects

Proximate sleep and breastfeeding are part of the same evolutionary system (Ball, 2017b). Anthropologists Gettler and McKenna coined the term “breastsleeping” to reflect

the evolutionary and physiological integration of these activities (J. J. McKenna & Gettler, 2015). Co-sleeping with breastfeeding is the physiological norm for humans and other primates. In traditional societies all over the world, infants are carried by their mothers 24 hours a day, nursing at will and sleeping with them at night (Barry & Paxson, 1971). Co-sleeping, including bedsharing, plays a key role in facilitating breastfeeding, and therefore contributes to the protective effects of breastfeeding for SUID/SIDS.

Routine bedsharing has no risk of SIDS compared with unintentional bedsharing (Vennemann et al., 2012). There is debate over whether bedsharing poses an independent risk factor for SIDS. Blair et al. 2014 found that there is no additional risk in absence of other risk factors, while the AAP has argued that bedsharing does pose an independent SIDS risk (AAP 2016).

In some cases, bedsharing occurs in combination with other risk factors. For instance, many mothers bedshare even if smoking and/or formula feeding (Lahr, Rosenberg, & Lapidus, 2007). Although the independent role of bedsharing in these combinations is not always clear, some of these behavioural combinations are associated with increased risk (Lahr et al., 2007), (Blair et al., 2014).

In turn, separate or solitary sleep also carries risk of early weaning (Huang et al., 2013) and stress to the infant. Infant cortisol levels remain high when infants are separated from their mothers at night and maternal-infant cortisol asynchrony occurs (Middlemiss, Granger, Goldberg, & Nathans, 2012).

SUIDS/SIDS prevention and bedsharing

Much attention has been given to SUID/SIDS and bedsharing, as infants have often been found dead while sleeping next to an adult, either in a bed, or in a sofa or recliner. As a result, numerous public health campaigns have strongly advised parents against bedsharing. US public health campaigns have included scary images such as a tombstone replacing the headboard of the adult bed. Such anti-bedsharing advice, however, may have inadvertently contributed to adverse outcomes, including a 4 fold rise in sofa deaths in the UK, as mothers fed infants on sofas and recliners at night in order to avoid bedsharing, then fell asleep there (Blair, Sidebotham, Berry, Evans, & Fleming, 2006; Kendall-Tackett, Cong, & Hale, 2010). Sofa-sharing poses far greater risk than sleeping next to an infant in an adult bed (Moon & Task Force On Sudden Infant Death, 2016). Because bedsharing facilitates breastfeeding and is associated with greater breastfeeding duration (Ball et al., 2016; Huang et al., 2013; J. McKenna, Mosko, & Richard, 1997), advice against bedsharing also has profound implications for the health of both women and children (Victora et al., 2016). In response to a systematic assessment of the evidence the UK has issued guidance that emphasizes the risks of smoking and sofa sharing, prioritizes room sharing and encourages a contextual, informed choice approach about bedsharing (Ball, 2017a; Bartick, Schwarz, et al., 2017). In 2016, the US's American Academy of Pediatrics (AAP), also issued guidance acknowledging similar risk factors, but maintained a more authoritative, less nuanced anti-bedsharing stance (Ball, 2017a). For instance, it advised all parents to conduct night-time feedings in the adult bed, but then to return the infant to a separate sleeping area (American Academy of

Pediatrics Task Force On Sudden Infant Death Syndrome, 2016). Despite a shift in medical guidance towards more complex conversations about prevention between health care providers and families, the framing of SUID/SIDS prevention continues to rely primarily on individual behavior modification with little acknowledgment of the broader social context in which SUID/SIDS risk is produced.

Conceptualizing social inequities and SUID/SIDS risk using syndemics theory

Poverty, racism and other forms of marginalization have been identified as key social drivers of disease (Commission on Social Determinants of Health & World Health Organization, 2008). Previous literature from the U.S. and around the world has documented the role of poverty, racism and other forms of marginalization in poor overall health as part of the emerging field of social determinants of health (Commission on Social Determinants of Health & World Health Organization, 2008) In the US, a review of the literature has found that "weathering," the "chronic allostatic load generated by the continuing adaptation to enduring structures of inequalities" (Geronimus, 1992), generates --or at least contributes--to observed health disparities among Blacks (Dresslers, Oths, & Gravlee, 2005). Increased cortisol levels due to acute and chronic stress have been described as an effect of racism (Adam et al., 2015; Richman & Jonassaint, 2008) and may reasonably be expected to increase with effects of housing and food insecurity. Chronic stress among urban US Black, but not Hispanic, pregnant women, is associated with flattening of the diurnal cortisol curve (Suglia et al., 2010).

These socially produced stressors have significant implications for birth outcomes. Chronic stress between pregnancies is associated with flattening of the normal diurnal cortisol variation and is associated with a low birth weight child in the subsequent pregnancy (Guardino et al., 2016). Maternal job strain is also associated with lower birth weight infants, and these effects are roughly doubled in US Black women compared to US white women (Oths, Dunn, & Palmer, 2001). Structural support can help mitigate some of these stressors. For instance, access to antenatal care is associated with lower infant mortality, and lower rates of preterm birth (C. R. Taylor, Alexander, & Hepworth, 2005). While housing insecurity may contribute to poor access to prenatal care, via multiple stressors and transportation issues (Desmond, 2016), targeted increased access to prenatal care to disadvantaged communities has been shown to reduce infant mortality (Meghea, You, Raffo, Leach, & Roman, 2015).

Social inequities contribute to negative birth outcomes including lower birth weight and preterm birth, which, in turn, influence the physiological risks of SUID/SIDS (Blair, Platt, Smith, Fleming, & Group, 2006). Poverty is associated with previously documented risk factors for SIDS in multiple settings, such as lower maternal educational level (Sosnaud, 2017), unmarried status and younger age (Spencer & Logan, 2004). Structural barriers and stressors are also reflected in behavioral risk factors for SUID/SIDS are often associated with lower socioeconomic status: lower rates of breastfeeding, maternal smoking and/or second hand smoke exposure (Zhang & Wang, 2013), parental drug/alcohol use (Blair et al., 2014), sofa sleeping (Moon & Task Force

On Sudden Infant Death, 2016), and non-supine positioning (Moon & Task Force On Sudden Infant Death, 2016). Of these, smoking and/or alcohol combined with bedsharing are especially hazardous, as is sofa-sharing.

Poverty is further implicated in poor access to prenatal care, which influences behavioral risk factors linked to increased risk of SUID/SIDS, since it deprives providers of opportunities to educate pregnant women in safe infant care practices, such as avoiding soft sleeping surfaces, intervene in smoking cessation, and provide education and support for breastfeeding. Moreover, poor breastfeeding support post-natally is also more common in US hospitals serving African American communities (Lind, Perrine, Li, Scanlon, & Grummer-Strawn, 2014), further contributing to SIDS risk. Thus, there is a clustering of multiple risk factors in marginalized communities, many of which face multiple forms of oppression and discrimination.

Teasing out the specific pathways in which co-occurring risks develop over time and lead to their clustering is made particularly difficult because some risks are independently associated with one another. Smoking is independently associated with lower socioeconomic status in the US, Japan, and northern Europe (Fukuda, Nakamura, & Takano, 2005; Kaneko et al., 2006; Loring, 2014), and is a cause of preterm birth (Wallace, Aland, Blatt, Moore, & DeFranco, 2017). Smoking is associated with early weaning (Liu, Rosenberg, & Sandoval, 2006). Alcohol use is associated with sofa-sharing (Blair et al., 2009). The association of SUID with social disadvantage was demonstrated in 51 of 52 case control and cohort studies between 1965 and 2002

(Spencer & Logan, 2004), most of which were done before the Back to Sleep campaigns. This association was independent of maternal smoking in 9 out of 10 studies (Spencer & Logan, 2004).

Anthropologists have used syndemic theory to describe similar patterns of disease clustering, wherein social inequities result in multiple, co-occurring epidemics that may interact to worsen some outcomes (Singer et al., 2017). These insights have generated a large body of research in population health, especially in examining the relationship of co-occurring psychosocial factors in the production of HIV-risk (Singer et al., 2017). Despite significant attention to SUID/SIDS, to date the clustering and social origins of co-occurring risk factors in marginalized populations has not been adequately theorized or examined in relation to Sudden Infant Death. Our paper takes up this charge by examining patterns of co-occurring risk factors and protective factors in low-prevalence and high-prevalence settings for SUID/SIDS.

Key Messages:

-SUID and SIDS are primarily conditions of poor and marginalized people with legacies of historical trauma living in wealthy countries.

-Syndemics theory highlights the social origins, clustering, and potential interaction of risk factors like poverty, marginalization, preterm birth and smoking

-Emphasis on bedsharing is misplaced, as low-prevalence populations have high to moderate rates of bedsharing.

-Comprehensive approaches to infant mortality are needed that address poverty, inequity, and racial discrimination and include structural interventions for smoking cessation and breastfeeding.

-Medical organizations should advocate for social equity as a means to health, but have missed opportunities to do so.

Methods:

Using available public data bases and the literature, we compared SIDS and SUID prevalence and their risk factors in Australia, Canada, Japan, New Zealand, the Netherlands, Sweden, the United Kingdom, and the United States, as well as specific subpopulations in Australia, Canada, New Zealand, and the US. Because rates of SIDS and SUIDS are rapidly changing, mostly decreasing, and smoking rates are also rapidly decreasing, preterm birth rates are decreasing, an effort was made to use those rates that are temporally aligned. For the US, we used linked birth/death data but this was not available or not labeled as such for New Zealand, Australia, Canada, or New Zealand.

In an effort to understand the high rates of SIDS and SUID in the US, we used the CDC/WONDER interactive database, which allowed us to examine these rates by the month prenatal care began in the affected infants, per racial and ethnic group for SIDS and SUID. We examined the percentages of timely and late prenatal care in US SUID/SIDS cases and in selected world populations. We calculated odds ratios (OR) with 95% confidence intervals (CI) on the odds of no and late prenatal care versus timely prenatal care for each US racial or ethnic group on the odds of SIDS and SUID.

Results:

See Tables 1-5 and literature below. Citations from the tables will not be repeated in the text.

Low-prevalence populations

The lowest SIDS prevalence is found in the Netherlands, followed by Japan and Sweden, similar to previous data (Hauck & Tanabe, 2008). Asian Americans have the fourth lowest prevalence of SIDS among the populations we studied (Tables 1 and 2). Of these four populations with lowest prevalence of SIDS and SUID, three -- Sweden, the Netherlands, and Japan -- enjoy universal health care and Sweden and the Netherlands have especially low income inequality (Table 1). Like every industrialized nation but the US, they also have paid maternity leave. Asian Americans have relatively greater wealth compared to other US groups - over twice the median household income of US Blacks and 1.3 times that of whites (Guzman, 2017).

Among Japanese, Swedes, and Asian Americans, both breastfeeding and bedsharing are very common (Table 1). Sweden had the highest bedsharing rate in all of Western Europe (Nelson et al., 2001) although it has decreased with recommendations against bedsharing (Stromberg Celind, Wennergren, Mollborg, Goksor, & Alm, 2017). With universal implementation of the Baby-Friendly Hospital Initiative (BFHI), Sweden also has exceptionally high breastfeeding rates (Table 1). Sweden has half the pregnancy -

smoking rate of the US (Table 1). In Japan only 16.9% of preschool aged children have their own bed (or futon) and only 1.4% have their own room (Mindell, Sadeh, Kwon, & Goh, 2013), as family interdependence is strongly valued in contrast to Western values of child independence (Jenni & O'Connor, 2005). Japan also has high breastfeeding rates. Japan, however, has had historically very high male smoking rates (Table 1).

Compared with the above three low-prevalence populations, the Netherlands has lower breastfeeding, moderate preterm birth rates but low overall infant mortality (Table 1), suggesting overall excellent access to health care. Low pregnancy-smoking rates compared to high population smoking rates may reflect that Dutch women have good access to prenatal care (Table 1), as such access has been shown to help pregnant women quit (Committee on Underserved Women & Committee on Obstetric Practice, 2017).

In the UK, which has a relatively low rate of SIDS, the proportion of SIDS deaths occurring in term infants has significantly decreased from 1984-2003 (Table 1), whereas the proportion in preterm infants has increased from 12% to 34% (Blair, Sidebotham, et al., 2006). Furthermore, the proportion of UK SIDS deaths occurring in families living in poverty has significantly increased from 47% to 74%, and the proportion of SIDS deaths in infants of mothers who smoked during pregnancy has significantly increased from 57% to 87% (Blair, Sidebotham, et al., 2006). The UK has exceptionally low rates of breastfeeding at 12 months compared to other industrialized nations (Victora et al., 2016). Current government SUID rates (see Table 1) do not include ASSB.

Canada and Australia may be becoming countries with lowest rates of SIDS but we would require SUID data to confirm that this is not merely diagnostic shift.

High-prevalence populations

In 2010, the United States led the world's high-income countries in the rate of post-neonatal SUID, and the US and New Zealand were tied for the world's highest rates of SIDS (B. J. Taylor et al., 2015), but by 2014 the US had surpassed even New Zealand for both SIDS and SUID (Centers for Disease Control and Prevention & National Center for Health Statistics, 2017 December; Ministry of Health, 2017b). In 2014, US AI/AN had the world's highest SUID rate and SIDS rate, while New Zealand Māori were second in SUID (Table 2). US AI/AN were highest in the world in SIDS, followed closely by US Blacks, while Māori were a distant third, much of it ASSB (Table 2). In 2010-12, the Māori rate of SIDS was 3.5 times that of the non-Māori, which is as low as that of Sweden, one of the world's lowest (Ministry of Health, 2015). By 2014, this gap lowered to 2.5, but the SUID rate in Māori was still 5.4 times that in non-Māori (Ministry of Health, 2017b). The pregnancy-smoking rate among European New Zealanders was just above that of Sweden. By contrast, in the US, even the SUID/SIDS rates among whites are very high, with SIDS rates nearly approaching those of Māori.

New Zealand Māori

New Zealand's overall SIDS rates are now moderate. The Māori, however, continue to experience disproportionately high rates.. Smoking rates among pregnant Māori are very

high, and hazardous alcohol use is also comparatively higher among Māori (Table 1). New Zealand, like Sweden, has universal implementation of the BFHI. Overall breastfeeding initiation rates are higher than those in Sweden, but Māori rates appear to be significantly lower that of non-Māori (Table 1). Bedsharing is comparatively much more common among Māori (Table 1). Indeed, New Zealand researchers found the combination of smoking and bedsharing increased the risk of SUID 32-fold compared to infants with neither of these risks (Mitchell et al., 2017).

U.S.

In the US, unlike Australia, New Zealand, and Canada, rates of SIDS and SUID are high even in the white population, but are markedly higher in the Black and American Indian/Alaskan Native (AI/AN) populations (Tables 1-2). Tables 3-5 show poor prenatal care is inversely associated with higher SIDS and SUID rates in a dose-response fashion for almost every US ethnic group, but most pronounced in Whites, Asians, and Hispanics (SUID only).

US Blacks

Average US Black family income is significantly lower than that of whites and US Blacks continue to experience pervasive racism as discussed above (United States Department of Labor Women's Bureau, 2015). While overall smoking rates are often equal to or lower than those in the countries with lowest SIDS/SUID rates, Black children have significantly greater exposure to second hand smoke: 67.9% compared to 37.2% for white children (2011-12) (Homa et al., 2015). Black parents are more likely to place

infants to sleep prone, and more likely to sleep with their infants outside an adult bed, such as a sofa (Unger et al., 2003). One Maryland study showed 9 of 10 co-sleeping asphyxia deaths were in Black infants, most commonly on sofas, even though all homes had cribs (Li, Zhang, Zielke, Ping, & Fowler, 2009). Finally, Blacks have the lowest breastfeeding rates of any US ethnic group. Suboptimal breastfeeding rates among non-Hispanic Blacks were determined to contribute to 1.95 the risk of SIDS in that population compared to non-Hispanic whites (Bartick, Jegier, et al., 2017).

U.S. American Indian/Alaskan Natives

AI/AN median income is 69% that of the general population, and 27% live in poverty, the highest of any ethnic group (US. Census Bureau, 2016), reflecting historical trauma enacted by colonization, and continued racism and discrimination. AI/AN have high rates of smoking and alcohol use. Bedsharing is comparatively more common than among whites (Table 1). Breastfeeding rates are the second lowest of US ethnic groups after Blacks. Recognizing this problem, in 2014 all Indian Health Service (IHS) Hospitals became Baby-Friendly. However, IHS facilities only serve just over half of American Indians (U.S. Department of Health and Human Services & Indian Health Service, 2018).

First Nation and Inuit in Canada

Although SIDS has declined in Canada overall, SIDS was the leading cause of infant mortality in First Nation and Inuit populations in 2004-06 (Sheppard et al., 2017). These populations also have similar experiences of historical trauma and poverty, and have very high smoking rates, and comparatively lower breastfeeding rates and the Inuit have

extremely high preterm birth rates. The Canadian government does not appear to routinely collect or publish infant health metrics by ethnicity. Bedsharing is very common in the Inuit communities and among breastfeeding First Nation mothers (Table 1). The combination of marginalization, poverty, smoking in combination with bedsharing with lower breastfeeding rates and poor access to prenatal care, especially in remote areas, likely contribute to the high death rate.

Australian Aborigine and Torres Strait Islanders

Australian Aborigine and Torres Strait Islanders are by far the most socio-economically disadvantaged sub-group in the Australian population with the worst overall health outcomes (Australian Government & Department of the Prime Minister and Cabinet, 2014; Greenhalgh, Bayly, & Winstaley, 2017). They have high rates of smoking with moderate bedsharing, and comparatively lower rates of breastfeeding. In one study, 81% of Aboriginal infants were placed on their sides to sleep and only 8% were placed on their backs (Eades & Read, 1999). The combination of poverty, high incidence of low birth weight infants, smoking paired with bedsharing, and lower breastfeeding and racial discrimination, likely explains high SUID/SIDS prevalence.

In the marginalized subpopulations in all four countries studied, the preterm birth rate or low birth weight rate outpaces that of the ethnically dominant populations, although less so in New Zealand. This is not mediated only by smoking as there are similar preterm birth rates in the Netherlands and among Māori despite many times the pregnancy-smoking rate among Māori, and very high rates among US Blacks with moderate

pregnancy-smoking rates. This suggests other complex factors related to access to care, poverty, and racism may be playing a role, as supported by a previous analysis (Spencer & Logan, 2004).

Discussion:

To our knowledge, this is the first work to employ syndemics theory to conceptualize and systematically examine the distribution of SIDS and SUIDS and the clustering of its risk factors in relation to underlying social inequities.

Our findings reflect the importance of social drivers of SUID/SIDS rates. Low-prevalence populations generally have better healthcare and less inequality, which is also linked to lower prevalence of poverty and fewer harmful health behaviors. In contrast, several high-prevalence populations have experienced historical trauma and racism, and continue to experience high rates of poverty, poorer access to high quality health care, and comparatively higher harmful health behaviors. The legacy of historical trauma plays an enduring role for generations of marginalized peoples. Australian Aborigines, Māori, American Indians, First Nation and many Inuit and Alaskan Native people have all had their lands confiscated and their traditional ways of life destroyed or upended by European colonization, and their populations decimated by European diseases to which they had no immunity. These communities also experience high rates of poverty and poorer health due to these historical legacies. Structural racism persists long after the end of slavery for African Americans, with generations left in poverty due to federal laws all

427 but prohibiting purchasing of real estate and accumulation of generational wealth, as but
428 one of many examples (Coates, 2014).
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430 The specific pathways in the socially-driven accumulation of co-occurring factors, and
431 their interplay are very complex and require additional study. It is not clear whether these
432 factors produce poor outcomes via only co-occurrence or whether they interact in a
433 synergistic manner, meeting the current definition of a syndemic (Tomori et al., 2018).
434 Multiple statistical approaches are available for examining the accumulation and potential
435 interactions among co-occurring risk factors (Tomori et al., 2018; Tsai, 2018; Tsai,
436 Mendenhall, Trostle, & Kawachi, 2017). Future syndemics studies of SUID/SIDS should
437 combine these quantitative approaches with in-depth qualitative studies to gain better
438 understanding of the production of risk and to develop more effective prevention
439 interventions.
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441 Our findings clearly indicate that factors that worsen income inequality, poverty, and
442 racial marginalization can be expected to increase infant mortality. The US has now
443 surpassed New Zealand as the world's leader in SIDS and SUID. The US has
444 experienced worsening income and educational inequality over the past several decades
445 (Greenstone, Looney, Patashnik, Yu, & The Hamilton Project, 2013), along with
446 concomitant rises in housing prices, which are now at a historic high percentage of
447 income (Kotkin, 2017). Additionally, inadequate government assistance to the poor
448 further contributes to poverty. For example, US food stamp benefits do not cover the cost
449 of meals in 99% of US counties (Dewey, 2018). In 2016, 41% of US children were either

poor or near-poor (Koball & Jiang, 2018). US infant mortality (5.9) exceeds the high-income country average of 5.3 per 100,000. Our data suggest that lack of prenatal care may play a large role in the high death rates even among US whites, although it is difficult to know if this is a marker for poverty as well as playing a causal role.

UK statisticians attribute their decrease in smoking directly to the drop in SUID rates (Patel, 2017), and this may be the case in other countries. However, smoking rates have declined in the US while SUID rates have not, possibly because gains in smoking cessation (and breastfeeding) are offset by factors related to rising poverty and persistent racial discrimination.

Infant mortality is considered a metric for the health of a society. In the US, SIDS is the third largest component of infant mortality after preterm birth and congenital anomalies (Centers for Disease Control and Prevention, 2018). The high US SIDS/SUID rates serve as a "canary in the coal mine" that US society has unacceptable social policies with regard to poor families and pregnant women, and particularly women of color. The US has neither paid maternity leave nor universal health care, and by far the highest metrics for income inequality. These factors can be expected to affect all segments of the population that are economically disadvantaged. In 2013, nearly 20% of US women had no health insurance just before they became pregnant and about 14% had none post-partum (Centers for Disease Control and Prevention, 2017).

Risk factors may compound one another or work to offset one another. The combination of bedsharing, high breastfeeding rates, low pregnancy smoking rates, and excellent access to care may result in very low infant death rates even with modest societal tobacco use, as in Sweden and Japan. By the same token, higher pregnancy-smoking and bedsharing rates, even with good access to care, may result in increased risk of SUID/SIDS (Māori). While bedsharing can be part of the cluster that produces higher SUID/SIDS prevalence, it can also be an important part of a set of protective behaviors, like breastfeeding.

The risk factors for the two biggest preventable causes of infant mortality, preterm birth and SIDS, largely overlap. These conditions should not be siloed, and undue focus on bedsharing at the expense of emphasis on tobacco exposure, prenatal care, and amelioration of poverty and racial discrimination will fail to result in sufficient reductions in infant mortality. Adverse health outcomes are related to income inequality, structural racism for those countries with populations of marginalized groups, social safety nets play an important role for vulnerable populations in addressing children's health. Parallel efforts to reduce preterm birth, including reducing antenatal smoking, will also help reduce infant death from co-sleeping and other causes.

Finally, given the role of numerous societal factors in the multiple interplaying risk factors for infant death, recommendations to individual parents and health care providers must be accompanied by recommendations for social policy makers in order to effect any meaningful change the rate of infant death. Individuals should not be expected to reverse

burdens placed on them by history and an inequitable social structure. Medical organizations' recommendations depend on individuals to take individual action, but as the problem of SUID/SIDS is much greater than the actions of any of individual, some solutions must ultimately originate from the policy level.

New Zealand has been successful in markedly bringing down both SIDS and SUID rates since 2009 (Ministry of Health, 2017a) and they should be looked at as a leader in this field, although marked disparities continue. Some success is undoubtedly attributable to the Wahakura and Pepi-pod on-the-bed sleeping devices (Abel & Tipene-Leach, 2013). The Wahakura was inspired by a revival of traditional Māori sleeping devices and was developed by and with the Māori community (Baddock et al., 2017; Bartholomew, 2017). Nearly all hospitals are now Baby-Friendly. The government collects and makes public all data on Māori and other minority groups for nearly every health metric examined here. New Zealand has also implemented a large stepwise tobacco tax as of 2017 (Radio New Zealand, 2017). The similar rates of preterm birth among the Netherlands and Māori may also represent success of the New Zealand maternity care system, where access to prenatal care is nearly equal between Māori and non-Māori, (Ministry of Health, 2012), illustrating success in preventing preterm births despite having twice the pregnancy smoking rate.

Limitations

This study is limited by the instability of the rates SIDS, SUID, and smoking in most of the populations studied. There may be diagnostic shift away from SIDS, as well as

lowering of SUID due to the secular trend in lower smoking rates. In addition, different countries may code infant deaths differently. Female alcohol related deaths may not adequately reflect current levels of hazardous drinking among new mothers, nor among co-sleeping fathers. There is no universal consistent definition of nearly every term in Table 1, and neither the Australian government nor the UK (England/Wales) government definitions of SUID include ASSB (W75). Even SIDS has no consistent definition across localities. We did not examine every risk factor for SUID/SIDS, such as pacifiers or swaddling. Within the bedsharing and sleep position statistics, variability exists that may further influence outcomes, such as sofa sharing, degree of usual bedsharing, and side versus prone sleep.

Recommendations

Structural interventions to reduce risk and enhance protective behaviors

Smoking: Although smoking rates are declining and are lower in the US than in some other countries, incremental change will help make bedsharing safer and reduce infant death. Tobacco-mediated infant death is thus best prevented by proven population-based tobacco control interventions in addition to individual smoking cessation advice and supportive interventions. Tobacco prices are most sensitive among younger and lower income people. Data from over 53 million births across 24 European countries showed that a price increase of $1.18 per pack of cigarettes was associated with a decline of 0.23 deaths per 1000 live births in the same year and 0.16 deaths per 1000 live births the following year (Filippidis, Laverty, Hone, Been, & Millett, 2017) Relief of stressful

living conditions, directly linked to poverty and racism, would also be important to recognize. Therefore supportive, rather than stigmatizing, interventions are needed.

Based on "strong evidence," the Community Preventive Services Task Force of the Centers for Disease Control and Prevention recommends increases in the unit price for tobacco as a means to decrease tobacco use (Community Preventive Services Task Force, 2017). Interestingly, price increases are not even mentioned as a possible strategy by either the AAP's tobacco prevention policy statement (Farber, Groner, Walley, Nelson, & Section On Tobacco, 2015) or by the American Cancer Society's Tobacco Atlas (Eriksen, Mackay, Schluger, Gomeshtapeh, & Drope, 2015).

Sidecars and on-the-bed sleeping devices such as Wahakura or Pepi-pods may minimize smokers' exposure to their infants in bed or prevent asphyxiation and SIDS. Their use should be further explored for acceptance, safety, and efficacy.

Breastfeeding: Governments and non-governmental organizations can help improve breastfeeding rates through investments and policies. Both Sweden and New Zealand have mandated and supported all hospitals to become Baby-Friendly and in the US publicly funded and privately funded efforts are targeting hospitals in parts of the country with the greatest breastfeeding disparities to become Baby-Friendly. As a result, breastfeeding rates have been proportionally increasing among African American and American Indian populations. Paid leave, peer counseling, and access to culturally-appropriate breastfeeding support are important. Equally important are medical and

564 governmental policies that do not undermine breastfeeding, such as policies that
565 inappropriately demonize bedsharing, or allow aggressive marketing of infant formula.
566
567 Building a Social Safety Net and Addressing Racism. The most challenging social
568 causes of risks to modify are poverty and racism. Infants, young children, and their
569 families are among society's most vulnerable members, and infant health begins during
570 pregnancy. Housing and food insecurity, poor access to prenatal care, smoking, and poor
571 breastfeeding support, all contribute to adverse health outcomes seen. At a minimum,
572 pregnant women and families need safe, stable housing and food security in order to
573 maximize the chances for health of their children. They also need universal access to
574 healthcare and paid parental leave. Access to care may help educate and ameliorate high
575 risk sleeping situations, as well as decrease the risk of poor birth outcomes.
576 Finally, ongoing efforts must bring the legacies of colonialism to light, as in the case of
577 the Truth and Reconciliation Commission in Canada (Truth and Reconciliation
578 Commission of Canada, 2015), and continue to systematically address racism and social
579 inequities. While raising tobacco prices and breastfeeding may augment these ongoing
580 trends in the US, the US may not see further reduction in reducing infant mortality until
581 there are substantive changes that affect poverty, inequity, and racial discrimination.
582 Indeed, without such changes, infant mortality in the US can reasonably be expected to
583 rise.
584
585 **Conclusions**—A syndemics analysis of SUID shows that it is primarily a condition of
586 poor and marginalized populations who continue to cope with the legacies of historical

trauma. SUID has many of the same risk factors as preterm birth. Smoking, poverty, alcohol/drug use, low breastfeeding rates, and unsafe sleep environments are common mediators of SUID and SIDS. A coordinated emphasis on reducing infant mortality by reducing tobacco use and preterm birth, addressing poverty and disparities, and promoting breastfeeding, would be much more effective than addressing SUID and SIDS in isolation. Misplaced emphasis on individual behavior practices like bedsharing, rather than on these combined factors will not be expected to lower infant mortality. The US stands out with its stagnant and high mortality rates and its increasing income inequality, high levels of child poverty, and the dismantling of the social safety net. These factors can reasonably be expected to result in increasing US SUID/SIDS and overall infant mortality rates in the future. Medical organizations play an important role in advocating for broad social policy change. The alarmingly high rate of preterm birth and SUID throughout most of the US population should serve as a call to action to reduce poverty, improve the social safety net, and ensure health care for all.

References

Abel, S., & Tipene-Leach, D. (2013). SUDI prevention: a review of Maori safe sleep innovations for infants. *N Z Med J, 126*(1379), 86-94.

Adam, E. K., Heissel, J. A., Zeiders, K. H., Richeson, J. A., Ross, E. C., Ehrlich, K. B., . . . Eccles, J. S. (2015). Developmental histories of perceived racial discrimination and diurnal cortisol profiles in adulthood: A 20-year prospective study. *Psychoneuroendocrinology, 62*, 279-291. doi:10.1016/j.psyneuen.2015.08.018

American Academy of Pediatrics Task Force On Sudden Infant Death Syndrome. (2016). SIDS and Other Sleep-Related Infant Deaths: Updated 2016 Recommendations for a Safe Infant Sleeping Environment. *Pediatrics, 138*(5). doi:10.1542/peds.2016-2938

Australian Government, & Department of the Prime Minister and Cabinet. (2014). *Aboriginal and Torres Strait Island Health Performance Framework 2014 Report* Retrieved from Canberra: https://www.pmc.gov.au/sites/default/files/publications/indigenous/Health-Performance-Framework-2014/index.html

Baddock, S. A., Tipene-Leach, D., Williams, S. M., Tangiora, A., Jones, R., Iosua, E., . . . Taylor, B. J. (2017). Wahakura Versus Bassinet for Safe Infant Sleep: A Randomized Trial. *Pediatrics, 139*(2). doi:10.1542/peds.2016-0162

Ball, H. L. (2006). Parent-infant bed-sharing behavior : Effects of feeding type and presence of father. *Hum Nat, 17*(3), 301-318. doi:10.1007/s12110-006-1011-1

Ball, H. L. (2017a). The Atlantic Divide: Contrasting U.K. and U.S. Recommendations on Cosleeping and Bed-Sharing. *J Hum Lact*, 890334417713943. doi:10.1177/0890334417713943

Ball, H. L. (2017b). Evolution-informed maternal-infant health. *Nat Ecol Evol, 1*(3), 73. doi:10.1038/s41559-017-0073

Ball, H. L., Howel, D., Bryant, A., Best, E., Russell, C., & Ward-Platt, M. (2016). Bed-sharing by breastfeeding mothers: who bed-shares and what is the relationship with breastfeeding duration? *Acta Paediatr, 105*(6), 628-634. doi:10.1111/apa.13354

635 Barry, H., & Paxson, L. M. (1971). Infancy and early childhood: Cross-cultural codes 2.
636 *Ethnology, 10*, 466-508.
637 Bartholomew, K. (2017, July 17). Hopes for Pepi-Pods to reduce Australia's alarming
638 infant mortality rate. *ABC Sunshine Coast*. Retrieved from
639 http://www.abc.net.au/news/2017-07-17/pepi-pods-rolled-out-to-reduce-
640 infant-mortality-rates/8716540
641 Bartick, M. C., Jegier, B. J., Green, B. D., Schwarz, E. B., Reinhold, A. G., & Stuebe, A.
642 M. (2017). Disparities in Breastfeeding: Impact on Maternal and Child Health
643 Outcomes and Costs. *J Pediatr, 181*, 49-55 e46. doi:10.1016/j.jpeds.2016.10.028
644 Bartick, M. C., Schwarz, E. B., Green, B. D., Jegier, B. J., Reinhold, A. G., Colaizy, T.
645 T., . . . Stuebe, A. M. (2017). Suboptimal breastfeeding in the United States:
646 Maternal and pediatric health outcomes and costs. *Matern Child Nutr, 13*(1).
647 doi:10.1111/mcn.12366
648 Blair, P. S., Platt, M. W., Smith, I. J., Fleming, P. J., & Group, C. S. R. (2006). Sudden
649 infant death syndrome and sleeping position in pre-term and low birth weight
650 infants: an opportunity for targeted intervention. *Arch Dis Child, 91*(2), 101-106.
651 doi:10.1136/adc.2004.070391
652 Blair, P. S., Sidebotham, P., Berry, P. J., Evans, M., & Fleming, P. J. (2006). Major
653 epidemiological changes in sudden infant death syndrome: a 20-year population-
654 based study in the UK. *Lancet, 367*(9507), 314-319. doi:10.1016/S0140-
655 6736(06)67968-3
656 Blair, P. S., Sidebotham, P., Evason-Coombe, C., Edmonds, M., Heckstall-Smith, E. M.,
657 & Fleming, P. (2009). Hazardous cosleeping environments and risk factors

amenable to change: case-control study of SIDS in south west England. *BMJ, 339*, b3666. doi:10.1136/bmj.b3666

Blair, P. S., Sidebotham, P., Pease, A., & Fleming, P. J. (2014). Bed-sharing in the absence of hazardous circumstances: is there a risk of sudden infant death syndrome? An analysis from two case-control studies conducted in the UK. *PLoS One*, *9*(9), e107799. doi:10.1371/journal.pone.0107799

Centers for Disease Control and Prevention. (2017). *Prevalence of Selected Maternal and Child Health Indicators-- United States, All Sites, Pregnancy Risk Assessment Monitoring System (PRAMS), 2012 and 2013*. Retrieved from Atlanta

Centers for Disease Control and Prevention. (2018). Infant Mortality. Retrieved from https://www.cdc.gov/reproductivehealth/maternalinfanthealth/infantmortality.htm

Centers for Disease Control and Prevention, & National Center for Health Statistics. (2017 December). Underlying Cause of Death 1999-2016 on CDC WONDER Online Database. Retrieved from http://wonder.cdc.gov/ucd-icd10.html

Coates, T. (2014). The Case for Reparations. *The Atlantic*.

Colson, E. R., Willinger, M., Rybin, D., Heeren, T., Smith, L. A., Lister, G., & Corwin, M. J. (2013). Trends and factors associated with infant bed sharing, 1993-2010: the National Infant Sleep Position Study. *JAMA Pediatr*, *167*(11), 1032-1037. doi:10.1001/jamapediatrics.2013.2560

Commission on Social Determinants of Health, & World Health Organization. (2008). *Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health*. Retrieved from Geneva

Committee on Underserved Women, & Committee on Obstetric Practice. (2017). Committee Opinion No. 721: Smoking Cessation During Pregnancy. *Obstet Gynecol, 130*(4), e200-e204. doi:10.1097/AOG.0000000000002353

Community Preventive Services Task Force. (2017). *What works: Tobacco Use: Evidence-Based Interventions for Your Community*. Retrieved from Atlanta: https://www.thecommunityguide.org/sites/default/files/assets/What-Works-Factsheet-Tobacco.pdf

Desmond, M. (2016). *Evicted: Poverty and proifit in the American city*. New York: Penguin Random House.

Dewey, C. (2018, February 28). Study: Food stamp benefits are already too low in 99% of U.S. counties. *Washington Post*. Retrieved from https://www.washingtonpost.com/news/wonk/wp/2018/02/28/study-food-stamp-benefits-are-already-too-low-in-99-percent-of-u-s-counties/?utm_term=.68c1d0d0fbb5

Dresslers, W. W., Oths, K. S., & Gravlee, C. C. (2005). Race and Ethnicity in Public Health Research: Models to Explain Health Disparities. *Annu Rev Anthropol, 34*, 231-252.

Duncan, J. R., Garland, M., Myers, M. M., Fifer, W. P., Yang, M., Kinney, H. C., & Stark, R. I. (2009). Prenatal nicotine-exposure alters fetal autonomic activity and medullary neurotransmitter receptors: implications for sudden infant death syndrome. *J Appl Physiol (1985), 107*(5), 1579-1590. doi:10.1152/japplphysiol.91629.2008

Eades, S. J., & Read, A. W. (1999). Infant care practices in a metropolitan aboriginal population Bibbulung Gnarneep Team. *J Paediatr Child Health, 35*(6), 541-544.

Eriksen, M., Mackay, J., Schluger, N. W., Gomeshtapeh, F. I., & Drope, J. (2015). The Tobacco Atlas. Retrieved from http://www.tobaccoatlas.org/

Farber, H. J., Groner, J., Walley, S., Nelson, K., & Section On Tobacco, C. (2015). Protecting Children From Tobacco, Nicotine, and Tobacco Smoke. *Pediatrics, 136*(5), e1439-1467. doi:10.1542/peds.2015-3110

Filippidis, F. T., Laverty, A. A., Hone, T., Been, J. V., & Millett, C. (2017). Association of Cigarette Price Differentials With Infant Mortality in 23 European Union Countries. *JAMA Pediatr, 171*(11), 1100-1106. doi:10.1001/jamapediatrics.2017.2536

Fukuda, Y., Nakamura, K., & Takano, T. (2005). Socioeconomic pattern of smoking in Japan: income inequality and gender and age differences. *Ann Epidemiol, 15*(5), 365-372. doi:10.1016/j.annepidem.2004.09.003

Garcia, A. J., 3rd, Koschnitzky, J. E., & Ramirez, J. M. (2013). The physiological determinants of sudden infant death syndrome. *Respir Physiol Neurobiol, 189*(2), 288-300. doi:10.1016/j.resp.2013.05.032

Geronimus, A. T. (1992). The weathering hypothesis and the health of African-American women and infants: evidence and speculations. *Ethn Dis, 2*(3), 207-221.

Greenhalgh, E. M., Bayly, M., & Winstaley, M. H. (2017). *1.9 Prevalence of tobacco use among Aboriginal and Torres Strait Islanders*. Retrieved from Melbourne: http://www.tobaccoinaustralia.org.au/chapter-1-prevalence/1-9-prevalence-of-tobacco-use-among-aboriginal-peo

Greenstone, M., Looney, A., Patashnik, J., Yu, M., & The Hamilton Project. (2013). *Thirteen Economic Facts About Social Mobility and the Role of Education*. Retrieved from Washington: https://www.brookings.edu/research/thirteen-economic-facts-about-social-mobility-and-the-role-of-education/

Guardino, C. M., Schetter, C. D., Saxbe, D. E., Adam, E. K., Ramey, S. L., Shalowitz, M. U., & Community Child Health, N. (2016). Diurnal salivary cortisol patterns prior to pregnancy predict infant birth weight. *Health Psychol, 35*(6), 625-633. doi:10.1037/hea0000313

Guzman, G. G. (2017). *Household Income: 2016*. Retrieved from Washington

Hauck, F. R., & Tanabe, K. O. (2008). International trends in sudden infant death syndrome: stabilization of rates requires further action. *Pediatrics, 122*(3), 660-666. doi:10.1542/peds.2007-0135

Homa, D. M., Neff, L. J., King, B. A., Caraballo, R. S., Bunnell, R. E., Babb, S. D., . . . Prevention. (2015). Vital signs: disparities in nonsmokers' exposure to secondhand smoke--United States, 1999-2012. *MMWR Morb Mortal Wkly Rep, 64*(4), 103-108.

Huang, Y., Hauck, F. R., Signore, C., Yu, A., Raju, T. N., Huang, T. T., & Fein, S. B. (2013). Influence of bedsharing activity on breastfeeding duration among US mothers. *JAMA Pediatr, 167*(11), 1038-1044. doi:10.1001/jamapediatrics.2013.2632

Hwang, S. S., Lu, E., Cui, X., Diop, H., Barfield, W. D., & Manning, S. E. (2015). Home care practices for preterm and term infants after hospital discharge in

748 Massachusetts, 2007 to 2010. *J Perinatol, 35*(10), 880-884.
749 doi:10.1038/jp.2015.90
750 Ion, R., & Bernal, A. L. (2015). Smoking and Preterm Birth. *Reprod Sci, 22*(8), 918-926.
751 doi:10.1177/1933719114556486
752 Jenni, O. G., & O'Connor, B. B. (2005). Children's sleep: an interplay between culture
753 and biology. *Pediatrics, 115*(1 Suppl), 204-216. doi:10.1542/peds.2004-0815B
754 Kaneko, A., Kaneita, Y., Yokoyama, E., Miyake, T., Harano, S., Suzuki, K., . . . Ohida,
755 T. (2006). Factors associated with exclusive breast-feeding in Japan: for activities
756 to support child-rearing with breast-feeding. *J Epidemiol, 16*(2), 57-63.
757 Kendall-Tackett, K., Cong, Z., & Hale, T. (2010). Mother-Infant Sleep Locations and
758 Nighttime Feeding Behavior: U.S. Data from the Survey of Mothers' Sleep and
759 Fatigue. *Clinical Lactation, 1*(Fall).
760 Kinney, H. C. (2009). Brainstem mechanisms underlying the sudden infant death
761 syndrome: evidence from human pathologic studies. *Dev Psychobiol, 51*(3), 223-
762 233. doi:10.1002/dev.20367
763 Kinney, H. C., & Thach, B. T. (2009). The sudden infant death syndrome. *N Engl J Med,*
764 *361*(8), 795-805. doi:10.1056/NEJMra0803836
765 Koball, H., & Jiang, Y. (2018). *Basic Facts about Low-Income Children*. Retrieved from
766 New York:
767 Kotkin, J. (2017, October 19). Rising rents are stressing out tenants and heightening
768 America's housing crisis. *Forbes.com*.
769 Lahr, M. B., Rosenberg, K. D., & Lapidus, J. A. (2007). Maternal-infant bedsharing: risk
770 factors for bedsharing in a population-based survey of new mothers and

771 implications for SIDS risk reduction. *Matern Child Health J, 11*(3), 277-286.
772 doi:10.1007/s10995-006-0166-z
773 Lewis, K. W., & Bosque, E. M. (1995). Deficient hypoxia awakening response in infants
774 of smoking mothers: possible relationship to sudden infant death syndrome. *J*
775 *Pediatr, 127*(5), 691-699.
776 Li, L., Zhang, Y., Zielke, R. H., Ping, Y., & Fowler, D. R. (2009). Observations on
777 increased accidental asphyxia deaths in infancy while cosleeping in the state of
778 Maryland. *Am J Forensic Med Pathol, 30*(4), 318-321.
779 doi:10.1097/PAF.0b013e31819df760
780 Lind, J. N., Perrine, C. G., Li, R., Scanlon, K. S., & Grummer-Strawn, L. M. (2014).
781 Racial disparities in access to maternity care practices that support breastfeeding-
782 United States, 2011. *MMWR. Morbidity and mortality weekly report, 63*(33), 725-
783 728.
784 Liu, J., Rosenberg, K. D., & Sandoval, A. P. (2006). Breastfeeding duration and perinatal
785 cigarette smoking in a population-based cohort. *Am J Public Health, 96*(2), 309-
786 314. doi:10.2105/AJPH.2004.060798
787 Loring, B. (2014). *Tobacco and inequities: Guidance for addressing inequities in*
788 *tobacco-related harm*. Retrieved from Copenhagen
789 McKenna, J., Mosko, S., & Richard, C. (1997). Bedsharing promotes breastfeeding.
790 *Pediatrics, 100*, 214-219.
791 McKenna, J. J., & Gettler, L. T. (2015). There is no such thing as infant sleep, there is no
792 such thing as breastfeeding, there is only breastsleeping. *Acta Paediatr, 105*(1),
793 17-21. doi:10.1111/apa.13161

794 Meghea, C. I., You, Z., Raffo, J., Leach, R. E., & Roman, L. A. (2015). Statewide
795 Medicaid Enhanced Prenatal Care Programs and Infant Mortality. *Pediatrics, 136*(2), 334-342. doi:10.1542/peds.2015-0479
796
797 Middlemiss, W., Granger, D. A., Goldberg, W. A., & Nathans, L. (2012). Asynchrony of
798 mother-infant hypothalamic-pituitary-adrenal axis activity following extinction of
799 infant crying responses induced during the transition to sleep. *Early Hum Dev, 88*(4), 227-232. doi:10.1016/j.earlhumdev.2011.08.010
800
801 Mindell, J. A., Sadeh, A., Kwon, R., & Goh, D. Y. (2013). Cross-cultural differences in
802 the sleep of preschool children. *Sleep Med*, *14*(12), 1283-1289.
803 doi:10.1016/j.sleep.2013.09.002
804 Ministry of Health. (2012). Report on Maternity 2010. Retrieved from
805 https://www.health.govt.nz/publication/report-maternity-2010
806 Ministry of Health. (2015). Infant health. Retrieved from
807 https://www.health.govt.nz/our-work/populations/maori-health/tatau-
808 kahukura-maori-health-statistics/nga-mana-hauora-tutohu-health-status-
809 indicators/infant-health
810 Ministry of Health. (2017a). Fetal and infant death data and stats. *Mortality Collection.*
811 Ministry of Health. (2017b). Fetal and Infant Deaths 2014. Retrieved from
812 https://www.health.govt.nz/publication/fetal-and-infant-deaths-2014
813 Mitchell, E. A., Thompson, J. M., Zuccollo, J., MacFarlane, M., Taylor, B., Elder, D., . . .
814 Fleming, P. (2017). The combination of bed sharing and maternal smoking leads
815 to a greatly increased risk of sudden unexpected death in infancy: the New
816 Zealand SUDI Nationwide Case Control Study. *N Z Med J, 130*(1456), 52-64.

817 Moon, R. Y., & Task Force On Sudden Infant Death, S. (2016). SIDS and Other Sleep-
818 Related Infant Deaths: Evidence Base for 2016 Updated Recommendations for a
819 Safe Infant Sleeping Environment. *Pediatrics, 138*(5). doi:10.1542/peds.2016-
820 2940
821 Mosko, S., Richard, C., & McKenna, J. (1997). Infant arousals during mother-infant bed
822 sharing: implications for infant sleep and sudden infant death syndrome research.
823 *Pediatrics, 100*(5), 841-849.
824 Nelson, E. A., Taylor, B. J., Jenik, A., Vance, J., Walmsley, K., Pollard, K., . . .
825 Nepomyashchaya, V. (2001). International Child Care Practices Study: infant
826 sleeping environment. *Early Hum Dev, 62*(1), 43-55.
827 Ostfeld, B. M., Schwartz-Soicher, O., Reichman, N. E., Teitler, J. O., & Hegyi, T. (2017).
828 Prematurity and Sudden Unexpected Infant Deaths in the United States.
829 *Pediatrics*. doi:10.1542/peds.2016-3334
830 Oths, K. S., Dunn, L. L., & Palmer, N. S. (2001). A prospective study of psychosocial job
831 strain and birth outcomes. *Epidemiology, 12*(6), 744-746.
832 Patel, V. (2017). *Unexplained deaths in infancy, England and Wales: 2015*. Retrieved
833 from Newport
834 Radio New Zealand. (2017). Tobacco tax increase comes in today. *New Zealand/Health.*
835 Retrieved from https://www.radionz.co.nz/news/national/321568/tobacco-
836 tax-increase-comes-in-today
837 Richman, L. S., & Jonassaint, C. (2008). The effects of race-related stress on cortisol
838 reactivity in the laboratory: implications of the Duke lacrosse scandal. *Ann Behav*
839 *Med, 35*(1), 105-110. doi:10.1007/s12160-007-9013-8

Schneider, J., Mitchell, I., Singhal, N., Kirk, V., & Hasan, S. U. (2008). Prenatal cigarette smoke exposure attenuates recovery from hypoxemic challenge in preterm infants. *Am J Respir Crit Care Med, 178*(5), 520-526. doi:10.1164/rccm.200803-432OC

Sheppard, A. J., Shapiro, G. D., Bushnik, T., Wllkins, R., Perry, S., Kaufman, J. S., . . . Yang, S. (2017). Birth outcomes among First Nations, Inuit, and Métis populations. *Health Reports.* Retrieved from http://www.statcan.gc.ca/pub/82-003-x/2017011/article/54886-eng.htm

Singer, M., Bulled, N., Ostrach, B., & Mendenhall, E. (2017). Syndemics and the biosocial conception of health. *Lancet, 389*(10072), 941-950. doi:10.1016/S0140-6736(17)30003-X

Sosnaud, B. (2017). Inequality in infant mortality: Cross-state variation and medical system institutions. *Social Problems, October*. doi:10.1093/socpro/spx034

Spencer, N., & Logan, S. (2004). Sudden unexpected death in infancy and socioeconomic status: a systematic review. *J Epidemiol Community Health, 58*(5), 366-373.

Stromberg Celind, F., Wennergren, G., Mollborg, P., Goksor, E., & Alm, B. (2017). Area-based study shows most parents follow advice to reduce risk of sudden infant death syndrome. *Acta Paediatr, 106*(4), 579-585. doi:10.1111/apa.13711

Suglia, S. F., Stuadenmayer, J., Cohen, S., Enlow, M., Rich-Edwards, J. W., & Wright, R. J. (2010). Cumulative stress and cortisol disruption among Black and Hispanic pregnant women in an urban cohort. *Psychological Trauma: Theory, Research, Practice, and Policy, 24*(4), 326-334.

Taylor, B. J., Garstang, J., Engelberts, A., Obonai, T., Cote, A., Freemantle, J., . . . Moon, R. Y. (2015). International comparison of sudden unexpected death in infancy rates using a newly proposed set of cause-of-death codes. *Arch Dis Child, 100*(11), 1018-1023. doi:10.1136/archdischild-2015-308239

Taylor, C. R., Alexander, G. R., & Hepworth, J. T. (2005). Clustering of U.S. women receiving no prenatal care: differences in pregnancy outcomes and implications for targeting interventions. *Matern Child Health J, 9*(2), 125-133. doi:10.1007/s10995-005-4869-3

Thompson, J. M. D., Tanabe, K., Moon, R. Y., Mitchell, E. A., McGarvey, C., Tappin, D., . . . Hauck, F. R. (2017). Duration of Breastfeeding and Risk of SIDS: An Individual Participant Data Meta-analysis. *Pediatrics, 140*(5). doi:10.1542/peds.2017-1324

Tomori, C., McFall, A. M., Solomon, S. S., Srikrishnan, A. K., Anand, S., Balakrishnan, P., . . . Celentano, D. D. (2018). Is there synergy in syndemics? Psychosocial conditions and sexual risk among men who have sex with men in India. *Soc Sci Med*. doi:10.1016/j.socscimed.2018.03.032

Truth and Reconciliation Commission of Canada. (2015). Truth and Reconciliation of Canada homepage. Retrieved from http://www.trc.ca/websites/trcinstitution/index.php?p=905

Tsai, A. C. (2018). Syndemics: A theory in search of data or data in search of a theory? *Soc Sci Med*. doi:10.1016/j.socscimed.2018.03.040

Tsai, A. C., Mendenhall, E., Trostle, J. A., & Kawachi, I. (2017). Co-occurring epidemics, syndemics, and population health. *Lancet, 389*(10072), 978-982. doi:10.1016/S0140-6736(17)30403-8

U.S. Department of Health and Human Services, & Indian Health Service. (2018). About IHS. Retrieved from https://www.ihs.gov/aboutihs/

Unger, B., Kemp, J. S., Wilkins, D., Psara, R., Ledbetter, T., Graham, M., . . . Thach, B. T. (2003). Racial disparity and modifiable risk factors among infants dying suddenly and unexpectedly. *Pediatrics, 111*(2), E127-131.

United States Department of Labor Women's Bureau. (2015). *Black Women in the Labor Force*. Retrieved from Washington, DC:

Vennemann, M. M., Bajanowski, T., Brinkmann, B., Jorch, G., Yucesan, K., Sauerland, C., & Mitchell, E. A. (2009). Does breastfeeding reduce the risk of sudden infant death syndrome? *Pediatrics, 123*(3), e406-410. doi:123/3/e406 [pii]

10.1542/peds.2008-2145

Vennemann, M. M., Hense, H. W., Bajanowski, T., Blair, P. S., Complojer, C., Moon, R. Y., & Kiechl-Kohlendorfer, U. (2012). Bed sharing and the risk of sudden infant death syndrome: can we resolve the debate? *J Pediatr, 160*(1), 44-48 e42. doi:10.1016/j.jpeds.2011.06.052

Victora, C. G., Bahl, R., Barros, A. J., Franca, G. V., Horton, S., Krasevec, J., . . . Lancet Breastfeeding Series, G. (2016). Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. *Lancet, 387*(10017), 475-490. doi:10.1016/S0140-6736(15)01024-7

Wallace, J. L., Aland, K. L., Blatt, K., Moore, E., & DeFranco, E. A. (2017). Modifying the risk of recurrent preterm birth: influence of trimester-specific changes in smoking behaviors. *Am J Obstet Gynecol, 216*(3), 310 e311-310 e318. doi:10.1016/j.ajog.2016.11.1034

Zhang, K., & Wang, X. (2013). Maternal smoking and increased risk of sudden infant death syndrome: a meta-analysis. *Leg Med (Tokyo), 15*(3), 115-121. doi:10.1016/j.legalmed.2012.10.007

Table 1. Comparison of Selected World Populations by SIDS rates, SUID rates, and Selected Risk Factors

	SIDS, ASSB per 1000 live births (2002-10)	SUID per 1000 live births (2002-10)-see notes	SIDS per 1000 live births (most recent gov't figures)	SUID per 1000 live births (most recent gov't figures) -see notes	Pre-term Birth (%) (2010)	Infant mortality rate per 1000 live births (2013)	Any breast-feeding at 6 months (%)	Pregnancy smoking rate (%) (2010), Female smoking rate (%) (2015)	Gini Coefficient and Quintile Ratios per nation, (2010-15)	Bedsharing as a cultural norm, at least sometimes (%)	Supine sleep as a cultural norm (%)	Alcoholic liver cirrhosis mortality in females per 100,000 (see notes)	Comments
Australia	0.31, 0.32	0.50	0.32 (2010) 0.07 (2015)	n/a	7.6	3.4	56 (2011) 60.1 (2010)	11.7, 13.1 (Male 16.7)	34.9, 6.0	30 (Brisbane)	No recent data available	2.0 (2010)	
Australian Aborigine/ Torres Strait Islander (2.8% population)	n/a	n/a	0.6 (2008-12)	1.2 (2008-12) – See notes	12.6 (Low birth-weight, 2011)	6.2 (2008-12)	45.4 (2010)	49.3, 42 (2012-13)		40 (South Australia)	8 (Perth)	20.3(2008-12, both sexes, "alcohol related disease")	
Australian non-Aboriginal	n/a	n/a	0.2 (2008-12)	0.4 (2008-12) See notes	6.0 (Low birth-weight, 2011)	3.7 (2008-12)	60.3 (2010)	12.1, Extrapolate to 17.3 (2012-12) (percentage of non-indigenous 18-24 year olds)		30 (Brisbane)	No recent data available	3.9 (2008-12, both sexes, "alcohol related disease")	
Canada	0.33,	0.45	0.24	n/a	7.8	4.6	30	10.5-23,	33.7, 5.8	23	77	3.3 (2012)	

	0.03		(2010) 0.06 (2013)				(2011-12)	12.2 (Male 17.7) (18.3 in (2006-10)		(Manitoba)			
Indigenous Canadians (4.9% population: 58% First Nation, 35% Métis, 3.9% Inuit)	1.2 (1991-2000 First Nation, 6.8 (1991-2000) Inuit in Quebec	5.7-6.1 (1999-2011) Inuit in Nunavut	2.0 (2004-06)	Does not collect	8.7 (2004-06) First Nation 8.2, Métis 6.3, Inuit 11.4	9.6 (2004-06) First Nation 7.5, Métis 7.1, Inuit 9.9	Initiation (2007-10)- 60.2-78.2	Female smoking rates: 39.4-59.3 (Northern Territories 2006 and 2010); 34.2 (Métis), 39.1 (First Nation), 48.9 (Inuit) (2006-10). Inuit women 73.6 (2012)		58-63 (Inuit) 100 among breast-feeding First Nation mothers (British Columbia, Manitoba, Ontario)	38-46 (Inuit Nunavut)	n/a	In First Nations families, family beds are common. Sofa-sharing with fathers described. Family beds may be piled high with blankets to stave off cold.
Canadian non-indigenous	n/a	n/a	0.3 (2004-06)	Does not collect	6.7 (2004-06)	4.4 (2004-06)	Initiation 87.8 2007-10)	non-indigenous pregnancy not known, 17.6 (2006-10)		23 (Manitoba)	77	n/a	
Japan	0.20, 0.06	0.60	0.1 (2015)	n/a	5.9	2.1	63 (2009)	5.1, 10.6 (Male 33.7)	32.1, 5.4	37 (Tokyo/ Yokahama). Likely under-estimate: as only16.9% preschool children have their own	97	1.8 (2012)	Note high male smoking rate; families sleeping together and sibling bedsharing is common.

										bed.			Sleeping on futons is common.
Netherlands	0.10, 0.02	0.19	0.09 (2013) 0.04 (2015)	n/a	8.0	3.3	32 (2006-08)	6.2, 23.9 (Male 26.2)	28.0, 4.5	40.4	84.6	1.7 (2012)	
New Zealand	0.62, 0.34	1.01 (1.02 per NZ gov't)	0.30 (2012-14)	0.75 (2014)	7.6 (7.4 per NZ gov't)	5.2 5.7 (2014)	60 (2006) 26% exclusive/full (2014)	18.4, no female data	33.5 (2010-14, NZ gov't Gini)	19 (Dunedin)	72 (Auckland)	1.4 (2012), Female hazardous drinking 11.7%/Male 27.2%	
NZ Māori (14.9% of population)	1.64	2.30 (SUID per NZ gov't)	0.45 (2012-14)	1.82 (2014)	8.1	7.2 (2014)	16% exclusive/full (2014-15-)	31.6 (2009-10), no female data		67.2 (includes Wahakura and Pepi-pod)	No data	Hazardous drinking Female 18.8%/Male 34.3%	
NZ non-Māori	0.39	0.51 (SUID per NZ gov't)	0.24 (2012-14)	0.34 (2014)	7.2	5.1 (2014)	30% exclusive/full (2014-15)	6.8 (2009-10) European, no female data		19 (Dunedin)	No data	European Female 11.6%/Male 27.5%	
Sweden	0.17 (2002-11), ASSB rate too low to be reliable	0.34 (2002-11)	0.18 (2013) 0.22 (2015)	n/a	5.9	2.4	52 (2010)	4.9, 20.8 (Male 20.4)	27.3, 4.2	65 (Stockholm) 44.2; 87.1 if breastfeed-ing (2012-14)	84.4	2.0 (2012)	
United Kingdom	0.28 (Eng.	0.45 (Eng.	0.18 (2014)	0.31 (2014),	7.8	3.9	34 (2005-	12, 18.4 (Male 19.9)	32.6, 5.3	32 (Scotland) 56 among	94.3 (white Bradford)	5.5 (2012)	

	and Wales), 0.02	and Wales)	0.17 (2015) (Eng. and Wales)	0.27 (2015) (Eng. and Wales) —See notes			10)			breast-feeding 84.4 (Bradford)	81.6 (Pakistani immigrants Bradford)		
United States	0.54 (0.53 CDC), 0.14	0.95 (0.95 CDC)	0.39 (2014)	0.87 (2014)	12.0	5.8 (2014)	49 (2011)	10.0, 13.6 (Male 18.1)	41.1, 9.1	61.4 (24.4 often/always)	78.4	4.4 (WHO 2012), (3.9 CDC 2010-14)	.
US Blacks (13.3% of population)	1.01, 0.32	1.88	0.67 (2014)	1.85 (2014)	17.1	10.9 (2014)	35 (2011)	8.5, 13.3		76.4 (35.3 often/always)	62.4	2.6 (2010-14)	Data suggests more common use of sofa-sharing compared to whites. High rates of second-hand smoke.
US AI/AN (1.3% of population)	1.17, 0.33	2.15	0.88 (2014)	1.92 (2014)	13.6	7.7 (2014)	37 (2011)	17.1, 24.0		83.9 (56.1 often/always)	80.2	26.0 (2010-14)	
US whites (76.9% of population)	0.53, 0.14	0.90	0.39 (2014)	0.82 (2014)	10.8	4.9 (2014)	52 (2011)	13.9, 16.0		52.7 (17.5 often/always)	83.9	3.4 (2010-14)	
US Hispanic (17.8% of population)	0.28, 0.06	0.53	0.24 (2014)	0.54 (2014)	11.8	5.0 (2014)	48 (2011)	2.0, 7.1		66.7 (28.7 often/always)	73.5	2.7 (2010-14)	
US Asian/Pacific Islander (Asian 5.7%; PI 0.2% of	0.23, 0.05	0.41	0.15 (2014)	0.29 (2014)	10.7	3.7 (2014)	71 (2011, Asian only)	1.3, 2.6 (Asian only)		76.8 (37.0 often/always)	79.2	0.5 (2010-14)	

population)													

General notes:

- AI/AN: American Indian/Alaskan Native; ASSB: Accidental Suffocation and Strangulation in Bed; CDC: Centers for Disease Control and Prevention; ICD: 10th Revision of the International Statistical Classification of Diseases; n/a: not available; NZ: New Zealand; PI: Pacific Islander; SIDS: sudden infant death syndrome; SUID: sudden unexpected infant death; WHO: World Health Organization.

-2002-2010 data come from (Taylor et al., 2015) for Australia, Canada, Japan, Netherlands, UK (England and Wales), US (overall). Sweden's data data is 2002-11 comes from (Möllborg, Wennergren, Almqvist, & Alm, 2015). New Zealand data is calculated from (Ministry of Health, 2017a) using the New Zealand government's definition of SUID, which is not spelled out. US subpopulation data was calculated using the exact SUID ICD-10 definitions used by Taylor et al using the CDC WONDER database using linked birth/death data (Centers for Disease Control and Prevention & National Center for Health Statistics, 2017 December).

-Recent government European SIDS rates come from (Eurostat, 2018).

-Most infant mortality data come from (World Health Organization, 2015), except for subpopulations in US, New Zealand, Canada.

-Preterm birth by country (2010) come from a joint report from the WHO (March of Dimes, PMNCH, Save the Children, & World Health Organization, 2012), except for subpopulations

-Breastfeeding rates come from the appendix to (Victora et al., 2016), unless otherwise specified for subpopulations.

-Most tobacco data come from (World Health Organization, 2016), except for subpopulations.

-Gini Coefficent and Quintile Ratios (indexes of income inequality) come from the United Nations Human Development Report 2016 (Jahan, Jespersen, & Human Development Report 2016 Team, 2016)

-Bedsharing at 3 months (Nelson et al., 2001) unless otherwise specified.

-Supine sleep data is reported by individual populations (see countries below).

-Mortality of Alcohol Use Disorders adult females, comes from (World Health Organization, 2014) unless otherwise stated. It is calculated by taking using listed rates in their tables for age standardized death rates for liver cirrhosis and multiplying it by the alcohol attributable fraction of liver cirrhosis. See separate note for the United States.

Australia notes

-Australian Aboriginal population data come from 2016 census.

-Australian SUID in Aborigines and non-Aborigines was defined as SIDS plus “signs, symptoms and ill-defined conditions” in the Australian Government Report for 2012-13, which would imply R99, but not W75.

-Preterm data was not available for Australian Aboriginal infants but low birthweight data came from Australian Government Report, for 2012-13(Australian Government & Department of the Prime Minister and Cabinet, 2014). This report also supplied alcohol mortality and infant mortality in Australian subpopulations (Australian Government & Department of the Prime Minister and Cabinet, 2014).

-Markedly different rates for Australian breastfeeding at 6 months between 2010 and 2011. (Australian Institute of Health and Welfare, 2018)

-Pregnancy smoking data comes from (Z. Li, Zeki, Hilder, & Sullivan, 2013).

-Aborigine bedsharing data comes from (Cunningham, Vally, & Bugeja, 2018).

-Australian Aborigine sleep position data from (Eades & Read, 1999).

Canada notes

-Subpopulation percentages come from the 2016 Canadian census.

-2004-06 SIDS rates for indigenous and non-indigenous Canadians come from (Sheppard et al., 2017).

-Preterm birth rates for indigenous and non-indigenous Canadians come from (Sheppard et al., 2017).

-2004-06 infant mortality rates for indigenous and non-indigenous Canadians come from (Sheppard et al., 2017).

-Breastfeeding rates in indigenous Canadian and non-indigenous include Métis (McIsaac, Moineddin, & Matheson, 2015). Data is extremely sparse and does not appear to be collected routinely for these populations.

-Pregnancy smoking data comes from (Al-Sahab, Saqib, Hauser, & Tamim, 2010) for 2006 and (Cui, Shooshtari, Forget, Clara, & Cheung, 2014) for 2010.

-Female Smoking data for indigenous Canadians come from (Physicians for a Smoke-Free Canada, 2013) and from (Bougie & Kohen, 2018).

-Sleep position in Inuit and Canada and bedsharing data in Inuit and Canada from (Collins et al., 2012).

-Bedsharing data from First Nation mothers comes from (Eni, Phillips-Beck, & Mehta, 2014).

Japan notes

-Japanese 2015 SIDS rates come from (Ministry of Health Labour and Welfare, 2016).

-Japanese pregnancy smoking data comes from (Yasuda et al., 2013).

-Japanese supine sleep and smoking rates from 2010-11 come from (Hirabayashi et al., 2016).

-Data on Japanese preschool children having their own bed comes from (Mindell, Sadeh, Kwon, & Goh, 2013).

Netherlands notes

-Netherlands bedsharing and sleep position data come from (van Sleuwen, L'Hoir, Engelberts, Westers, & Schulpen, 2003).

-Smoking in pregnancy data comes from (Zeitlin, Mohangoo, & Delnord, 2012).

New Zealand (NZ) notes

-New Zealand subpopulation data comes from 2017 New Zealand census.

-New Zealand SIDS and SUID data for 2002-2010 calculated from (Ministry of Health, 2017a). SUID was defined by NZ government.

-New Zealand SUID 2014 data calculated by adding R95, R99, and W75 from (Ministry of Health, 2017b).

-New Zealand subpopulation preterm birth data taken from (Ministry of Health, 2012).

-2014 infant mortality rates from NZ and subpopulations come from New Zealand Government report (Ministry of Health, 2017b).

-New Zealand breastfeeding data for 2014 come from 2010-2015 data from (Royal New Zealand Plunket Society, 2017).

-Antenatal smoking rates from New Zealand and subpopulations (2010) come from (Humphrey, Rossen, Walker, & Bullen, 2016).

-UN did not publish Gini coefficent or Quintile Ratio for New Zealand. New Zealand Gini coefficient came from (Ministry of Social Development, 2016).

-Alcohol use in New Zealand subpopulations comes from (Ministry of Health, 2004).

-Sleep position data comes from (Hutchison, Stewart, & Mitchell, 2006).

- Māori bedsharing data from (Jones, Cornsweet Barber, Waimarie Nikora, & Middlemiss, 2017).

Sweden notes

-Swedish data for 2002-11 comes from (Möllborg et al., 2015), as Sweden was not included in the Taylor study. It is unclear if every case of SUID was included. Total live births in Sweden 2002-11 numbered 762,626 from (Statistika Centralbyrån- Statistics Sweden, 2018).

-Smoking in pregnancy data comes from (Zeitlin et al., 2012).

-Swedish 2010-14 bedsharing and sleep position data is from (Stromberg Celind, Wennergren, Mollborg, Goksor, & Alm, 2017).

United Kingdom (UK) notes

-UK (England and Wales) SIDS and SUID rates from 2014 and 2015 come from (Patel, 2017). The description notes they use linked birth-death data for R95 and R99 but do not mention W75. Thus, these may be gross underestimates for SUID.

-Smoking in pregnancy data comes from (Zeitlin et al., 2012).

-Bedsharing data among breastfeeding mothers (at least “intermittently” or “often”) comes from (Ball et al., 2016) but there was insufficient data for 22% of respondents.

-Bedsharing and supine sleep data among the Bradford sample comes from (Ball et al., 2012).

United States (US) notes

Note: White, Black, American Indian/Alaskan Native (AI/AN), and Asian/Pacific Islander (PI) are all “non-Hispanic.”

-US subpopulation census estimates come from 2016 census estimates and include both non-Hispanic and Hispanic (United States Census Bureau, 2018).

-SIDS rates for 2002-2010 for US subpopulations calculated from CDC WONDER(Centers for Disease Control and Prevention & National Center for Health Statistics, 2017 December). SIDS and SUID subpopulation data also come from CDC WONDER. SUID for 2014 defined as R95, R99, and W75.

-Preterm birth rates in US and subpopulations come from (US Department of Health and Human Services, Health Resources and Services Administration, & Maternal and Child Health Bureau, 2012).

-SUID rates for US subpopulations 2002-2010 were calculated from CDC WONDER using the same ICD-10 codes from Taylor (2015): R95, R96, R98, R99, W75, W78, W79 (Centers for Disease Control and Prevention & National Center for Health Statistics, 2017 December). Note, this gave a total SUID rate of 0.96.

-US subpopulation infant mortality data (2014) come from (National Center for Health Statistics (US), 2017).

-Breastfeeding data from US subpopulations comes (Centers for Disease Control and Prevention, 2017a).

-Smoking in pregnancy data comes from (Child Trends Data Bank, 2016).

-Female and male smoking rates for US and subpopulations for 2015 come from (Jamal et al., 2016).

-Bedsharing and supine sleep data come from US Pregnancy Risk Assessment Monitoring System data in 2015 (Bombard et al., 2018).

-Sofa-sharing data in US Blacks comes from mortality data in (L. Li, Zhang, Zielke, Ping, & Fowler, 2009; Unger et al., 2003).

-Second hand smoke data in US Blacks and smoking rates in US subpopulations in US Blacks comes from CDC WONDER (Centers for Disease Control and Prevention, 2017b).

-CDC WONDER is the source for 2010-14, among females, all ages, per 100,000 persons(Centers for Disease Control and Prevention & National Center for Health Statistics, 2017 December). Rates reflect all "Alcoholic Liver Disease" (ICD-10 codes K70.0, K70.1, K70.3, K70.4, K70.9) to better approximate the values estimated by the WHO. When just the ICD-10 code for alcoholic cirrhosis is used, K70.3, the overall US rate was 2.6, far lower than the WHO estimate. Using this code alone, rates for US Blacks are: 1.8, for AI/AN 14.6, for whites 2.9, for Hispanics 2.0, and for Asian/Pacific Islanders 0.3.

References

Al-Sahab, B., Saqib, M., Hauser, G., & Tamim, H. (2010). Prevalence of smoking during pregnancy and associated risk factors among Canadian women: a national survey. *BMC Pregnancy Childbirth, 10*, 24. doi:10.1186/1471-2393-10-24

Australian Government, & Department of the Prime Minister and Cabinet. (2014). *Aboriginal and Torres Strait Island Health Performance Framework 2014 Report* Retrieved from Canberra: https://www.pmc.gov.au/sites/default/files/publications/indigenous/Health-Performance-Framework-2014/index.html

Australian Institute of Health and Welfare. (2018). *2010 Australian national infant feeding survey: indicator results*. Retrieved from Canberra:

Ball, H. L., Howel, D., Bryant, A., Best, E., Russell, C., & Ward-Platt, M. (2016). Bed-sharing by breastfeeding mothers: who bed-shares and what is the relationship with breastfeeding duration? *Acta Paediatr, 105*(6), 628-634. doi:10.1111/apa.13354

Ball, H. L., Moya, E., Fairley, L., Westman, J., Oddie, S., & Wright, J. (2012). Infant care practices related to sudden infant death syndrome in South Asian and White British families in the UK. *Paediatr Perinat Epidemiol, 26*(1), 3-12. doi:10.1111/j.1365-3016.2011.01217.x

Bombard, J. M., Kortsmit, K., Warner, L., Shapiro-Mendoza, C. K., Cox, S., Kroelinger, C. D., . . . Barfield, W. D. (2018). Vital Signs: Trends and Disparities in Infant Safe Sleep Practices - United States, 2009-2015. *MMWR Morb Mortal Wkly Rep, 67*(1), 39-46. doi:10.15585/mmwr.mm6701e1

Bougie, E., & Kohen, D. E. (2018). *Smoking correlates among Inuit men and women in Inuit Nunangat*. Retrieved from Ottawa:

Centers for Disease Control and Prevention. (2017a). Breastfeeding Among U.S. Children Born 2002-2014, CDC National Immunization Survey. Retrieved from https://www.cdc.gov/breastfeeding/data/nis_data/results.html

Centers for Disease Control and Prevention. (2017b). Tobacco-Related Disparities. *Smoking & Tobacco Use.* Retrieved from https://www.cdc.gov/tobacco/disparities/index.htm

Centers for Disease Control and Prevention, & National Center for Health Statistics. (2017 December). Underlying Cause of Death 1999-2016 on CDC WONDER Online Database. Retrieved from http://wonder.cdc.gov/ucd-icd10.html

Child Trends Data Bank. (2016). *Mothers Who Smoke While Pregnant*. Retrieved from Bethesda

Collins, S. A., Surmala, P., Osborne, G., Greenberg, C., Bathory, L. W., Edmunds-Potvin, S., & Arbour, L. (2012). Causes and risk factors for infant mortality in Nunavut, Canada 1999-2011. *BMC Pediatr, 12*, 190. doi:10.1186/1471-2431-12-190

Cui, Y., Shooshtari, S., Forget, E. L., Clara, I., & Cheung, K. F. (2014). Smoking during pregnancy: findings from the 2009-2010 Canadian Community Health Survey. *PLoS One, 9*(1), e84640. doi:10.1371/journal.pone.0084640

Cunningham, H. M., Vally, H., & Bugeja, L. (2018). Bed-Sharing in the First 8 Weeks of Life: An Australian Study. *Matern Child Health J, 22*(4), 556-564. doi:10.1007/s10995-017-2424-7

Eades, S. J., & Read, A. W. (1999). Infant care practices in a metropolitan aboriginal population Bibbulung Gnarneep Team. *J Paediatr Child Health, 35*(6), 541-544.

Eni, R., Phillips-Beck, W., & Mehta, P. (2014). At the edges of embodiment: determinants of breastfeeding for first nations women. *Breastfeed Med, 9*(4), 203-214. doi:10.1089/bfm.2013.0129

Eurostat. (2018). Causes of death: Infant mortality. Retrieved from http://ec.europa.eu/eurostat/web/health/causes-death/data/database

Hirabayashi, M., Yoshinaga, M., Nomura, Y., Ushinohama, H., Sato, S., Tauchi, N., . . . Nagashima, M. (2016). Environmental risk factors for sudden infant death syndrome in Japan. *Eur J Pediatr, 175*(12), 1921-1926. doi:10.1007/s00431-016-2786-7

Humphrey, G., Rossen, F., Walker, N., & Bullen, C. (2016). Parental smoking during pregnancy: findings from the Growing Up in New Zealand cohort. *N Z Med J, 129*(1442), 60-74.

Hutchison, L., Stewart, A. W., & Mitchell, E. (2006). SIDS-protective infant care practices among Auckland, New Zealand mothers. *N Z Med J, 119*(1247), U2365.

Jahan, S., Jespersen, E., & Human Development Report 2016 Team. (2016). *Human Development Report 2016: Human Development for Everyone*. Retrieved from New York

Jamal, A., King, B. A., Neff, L. J., Whitmill, J., Babb, S. D., & Graffunder, C. M. (2016). Current Cigarette Smoking Among Adults - United States, 2005-2015. *MMWR Morb Mortal Wkly Rep, 65*(44), 1205-1211. doi:10.15585/mmwr.mm6544a2

Jones, H., Cornsweet Barber, C., Waimarie Nikora, L., & Middlemiss, W. (2017). Māori child rearing and infant sleep practices *New Zealand Journal of Psychology, 46*(3), 30-37.

Li, L., Zhang, Y., Zielke, R. H., Ping, Y., & Fowler, D. R. (2009). Observations on increased accidental asphyxia deaths in infancy while cosleeping in the state of Maryland. *Am J Forensic Med Pathol, 30*(4), 318-321. doi:10.1097/PAF.0b013e31819df760

Li, Z., Zeki, R., Hilder, L., & Sullivan, E. A. (2013). *Australian Mothers and Babies 2010*. Retrieved from Canberra

March of Dimes, PMNCH, Save the Children, & World Health Organization. (2012). *Born Too Soon: The Global Action Report on Preterm Birth*. Retrieved from Geneva:

McIsaac, K. E., Moineddin, R., & Matheson, F. I. (2015). Breastfeeding as a means to prevent infant morbidity and mortality in Aboriginal Canadians: A population prevented fraction analysis. *Can J Public Health, 106*(4), e217-222. doi:10.17269/cjph.106.4855

Mindell, J. A., Sadeh, A., Kwon, R., & Goh, D. Y. (2013). Cross-cultural differences in the sleep of preschool children. *Sleep Med, 14*(12), 1283-1289. doi:10.1016/j.sleep.2013.09.002

Ministry of Health. (2004). *An Indication of New Zealanders' Health 2004*. Retrieved from Wellington: http://www.moh.govt.nz/notebook/nbbooks.nsf/0/C00B2B829BFFC352CC256EF1007F7EA1/$file/anindication.pdf

Ministry of Health. (2012). *Report on Maternity 2010*. Retrieved from Wellington

Ministry of Health. (2017a). Fetal and infant death data and stats. *Mortality Collection.*

Ministry of Health. (2017b). Fetal and Infant Deaths 2014. Retrieved from https://www.health.govt.nz/publication/fetal-and-infant-deaths-2014

Ministry of Health Labour and Welfare. (2016). *Handbook of Health and Welfare Statistics 2016, Table 1-26*. Retrieved from Tokyo:

Ministry of Social Development. (2016). The Social Report 2016: Economic standard of living-Income inequality. Retrieved from http://socialreport.msd.govt.nz/economic-standard-of-living/income-inequality.html

Möllborg, P., Wennergren, G., Almqvist, P., & Alm, B. (2015). Bed sharing is more common in sudden infant death syndrome than in explained sudden unexpected deaths in infancy. *Acta Paediatr, 104*(8), 777-783. doi:10.1111/apa.13021

National Center for Health Statistics (US). (2017). *Chartbook on Long-term Trends in Health*. Retrieved from Hyattsville, MD

Nelson, E. A., Taylor, B. J., Jenik, A., Vance, J., Walmsley, K., Pollard, K., . . . Nepomyashchaya, V. (2001). International Child Care Practices Study: infant sleeping environment. *Early Hum Dev, 62*(1), 43-55.

Patel, V. (2017). *Unexplained deaths in infancy, England and Wales: 2015*. Retrieved from Newport

Physicians for a Smoke-Free Canada. (2013). *Smoking among Aboriginal Canadians*. Retrieved from Ottawa: http://www.smoke-free.ca/factsheets/pdf/cchs/aboriginal.pdf

Royal New Zealand Plunket Society. (2017). *Breastfeeding Data: Analysis of 2010-2015 data*. Retrieved from Wellington:

Sheppard, A. J., Shapiro, G. D., Bushnik, T., Perry, S., Kaufman, J. S., Kramer, M. S., & Yang, S. (2017). *Birth outcomes among First Nations, Inuit, and Métis populations*. Retrieved from Ottawa:

Statistika Centralbyrån- Statistics Sweden. (2018). Live births by year. Retrieved from http://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BE__BE0101__BE0101H/FoddaK/table/tableViewLayout1/?rxid=18bf5c2b-1093-489c-a7bd-518e929b8ed2

Stromberg Celind, F., Wennergren, G., Mollborg, P., Goksor, E., & Alm, B. (2017). Area-based study shows most parents follow advice to reduce risk of sudden infant death syndrome. *Acta Paediatr, 106*(4), 579-585. doi:10.1111/apa.13711

Taylor, B. J., Garstang, J., Engelberts, A., Obonai, T., Cote, A., Freemantle, J., . . . Moon, R. Y. (2015). International comparison of sudden unexpected death in infancy rates using a newly proposed set of cause-of-death codes. *Arch Dis Child, 100*(11), 1018-1023. doi:10.1136/archdischild-2015-308239

Unger, B., Kemp, J. S., Wilkins, D., Psara, R., Ledbetter, T., Graham, M., . . . Thach, B. T. (2003). Racial disparity and modifiable risk factors among infants dying suddenly and unexpectedly. *Pediatrics, 111*(2), E127-131.

United States Census Bureau. (2018). Quick Fact United States. Retrieved from https://www.census.gov/quickfacts/fact/table/US/RHI425216 - viewtop

US Department of Health and Human Services, Health Resources and Services Administration, & Maternal and Child Health Bureau. (2012). *Child Health USA 2012*. Retrieved from Rockville

van Sleuwen, B. E., L'Hoir, M. P., Engelberts, A. C., Westers, P., & Schulpen, T. W. (2003). Infant care practices related to cot death in Turkish and Moroccan families in the Netherlands. *Arch Dis Child, 88*(9), 784-788.

Victora, C. G., Bahl, R., Barros, A. J., Franca, G. V., Horton, S., Krasevec, J., . . . Lancet Breastfeeding Series, G. (2016). Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. *Lancet, 387*(10017), 475-490. doi:10.1016/S0140-6736(15)01024-7

World Health Organization. (2014). *Global status report on alcohol and health 2014*. Retrieved from Geneva

World Health Organization. (2015). *World Health Statistics 2015*. Retrieved from Geneva:

World Health Organization. (2016). Tobacco use data by country. Retrieved from http://apps.who.int/gho/data/node.main.65

Yasuda, T., Ojima, T., Nakamura, M., Nagai, A., Tanaka, T., Kondo, N., . . . Yamagata, Z. (2013). Postpartum smoking relapse among women who quit during pregnancy: cross-sectional study in Japan. *J Obstet Gynaecol Res, 39*(11), 1505-1512. doi:10.1111/jog.12098

Zeitlin, J., Mohangoo, A., & Delnord, M. (2012). *European Perinatal Health Report: Health and Care of Pregnant Women and Babies in Europe in 2010*. Retrieved from Brussels:

Table 2. Rates of SIDS, ASSB, SUID, 2014, in selected US and New Zealand Populations, per 1000 live births

	SIDS	ASSB	SUID
US American Indian/Alaskan Native	0.84	Not reliable	1.92
US Blacks	0.74	0.52	1.70
New Zealand Māori	Not reliable	1.40	1.82
United States	0.39	0.21	0.87
US whites	0.38	0.20	0.82
New Zealand	0.24	0.52	0.75
US Hispanic	0.24	0.11	0.54
New Zealand non-Māori	Not reliable	Not reliable	0.34
US Asian	0.15	Not reliable	0.29

Note: SUID as defined as R-95 R-99, and W-75. (American Indian/Alaskan Native, Black, and white refer to non-Hispanics only). US data are linked birth/death data. US Data come from (Centers for Disease Control and Prevention & National Center for Health Statistics, 2017 December). New Zealand data is not stated as being linked and comes from (Ministry of Health, 2017). Numbers were denominator is less than 20 are considered "not reliable." ASSB: Accidental Suffocation and Strangulation in Bed; SIDS: sudden infant death syndrome; SUID: sudden unexpected infant death.

References:

Centers for Disease Control and Prevention, & National Center for Health Statistics. (2017 December). Underlying Cause of Death 1999-2016 on CDC WONDER Online Database. Retrieved from http://wonder.cdc.gov/ucd-icd10.html

Ministry of Health. (2017). Fetal and Infant Deaths 2014. Retrieved from https://www.health.govt.nz/publication/fetal-and-infant-deaths-2014

Table 3. US SIDS and SUID rates per 1000 live births, by subpopulation, by month prenatal care started, 2010-2015

	SIDS, No prenatal care	SIDS, Third tri-mester	SIDS, Second tri-mester	SIDS, First tri-mester	SIDS, over-all	SUID, No prenatal care	SUID, Third tri-mester	SUID, Second tri-mester	SUID, First tri-mester	SUID, overall
US overall	1.03	0.74	0.62	0.32	0.43	2.50	1.53	1.28	0.67	0.88
Black	1.37	0.98	0.96	0.62	0.80	3.72	2.30	2.13	1.40	1.58
AI/AN	Un-reliable	Unreliable	1.29	0.85	1.00	Un-reliable	2.33	2.48	1.88	1.98
White	1.27	0.82	0.68	0.33	0.43	2.65	1.71	1.37	0.66	0.72
Hispanic	0.46	0.43	0.34	0.19	0.25	1.43	0.81	0.71	0.40	0.72
Asian/PI	Un-reliable	0.42	0.24	0.13	0.17	Un-reliable	0.65	0.45	0.26	0.29

Note. Figures in which the numerator is under 20 are deemed as "unreliable." Overall figures include infants for whom prenatal care was not listed on certificate or those whose prenatal care status was listed as "excluded." Black, AI/AN, White, and Asian/PI are all non-Hispanic. AI/AN: American Indian/Alaskan Native; PI: Pacific Islander; SIDS: sudden infant death syndrome; SUID: sudden unexpected infant death. Source: CDC WONDER linked birth-death records (Centers for Disease Control and Prevention & National Center for Health Statistics, 2017 December), using R95 (SIDS) and R95, R98, R99, and W75 (SUID).

Reference:

Centers for Disease Control and Prevention, & National Center for Health Statistics. (2017 December). Underlying Cause of Death 1999-2016 on CDC WONDER Online Database. Retrieved from http://wonder.cdc.gov/ucd-icd10.html

Table 4. Percentage of SIDS and SUID cases that received timely (ie, first trimester) prenatal care or late (third trimester) or no prenatal care, by racial/ethnic group, and overall prevalence of late or no prenatal care

	SIDS cases with timely prenatal, 2010-15 (%)	SIDS cases with timely prenatal care, 2010-15 (%)	Timely prenatal care (%)	SIDS cases with late or no prenatal care (%) 2010-15	SUID cases with late or no prenatal care (%), 2010-15	Prevalence of late or no prenatal care xs(%)
US overall	45.1	46.0	74.1 (2012)	9.1	9.9	6.0 (2014)
US Black	38.3	39.6	63.6 (2012)	10.4	11.8	4.3 (2014)
US AI/AN	37.9	30.3	59.4 (2012)	12.1	12.0	10.8 (2014)
US white	48.7	49.8	79.0 (2012)	7.4	7.6	5.2 (2014)
US Hispanic	53.9	32.8	69.0 (2012)	14.3	8.6	7.5 (2014)
US Asian/PI	50.2	50.1	78.0 (2012, Asian only)	10.6	9.4	5.7 (2014)
Australia			65 (2015)			
Australia indigenous			57 (2015)			
Australia non-indigenous			63 (2015)			
Japan						0.3 (no care 2009)
Netherlands			87.3 (2010)			6.2 (2010)
UK: England			77.6 (2010)			9.6 (2010)
UK: Scotland			87.3 (2010)			2.3 (2010)

Note. Black, AI/AN, White, and Asian/PI are all non-Hispanic. AI/AN: American Indian/Alaskan Native; PI: Pacific Islander; SIDS: sudden infant death syndrome; SUID: sudden unexpected infant death. Sources: CDC WONDER for SIDS and SUID cases 2010-2014 (Centers for Disease Control and Prevention & National Center for Health Statistics, 2017 December). US data comes from (Child Trends Data Bank, 2015). Black, American Indian/Alaskan Native, White, and Asian/Pacific Islander are all non-Hispanic. England, Scotland, Netherlands data come from Euro-PERISTAT (Zeitlin, Mohangoo, &

Delnord, 2012). Japan data comes from (Unno, 2011). Australian data comes from (Australian Government Institute of Health and Welfare, 2015). Timely prenatal care is defined as first trimester; late prenatal care is defined as third trimester.

References:

Australian Government Institute of Health and Welfare. (2015). *Australia's mothers and babies 2015*. Retrieved from Canberra

Centers for Disease Control and Prevention, & National Center for Health Statistics. (2017 December). Underlying Cause of Death 1999-2016 on CDC WONDER Online Database. Retrieved from http://wonder.cdc.gov/ucd-icd10.html

Child Trends Data Bank. (2015). *Late or No Prenatal Care*. Retrieved from Bethesda

Unno, N. (2011). The Perinatal Care System in Japan. *JMAJ, 54*(4), 234-240.

Zeitlin, J., Mohangoo, A., & Delnord, M. (2012). *European Perinatal Health Report: Health and Care of Pregnant Women and Babies in Europe in 2010*. Retrieved from Paris

Table 5. Odds Ratios of the effect of no/late prenatal care to first trimester prenatal care to SIDS/SUID, by US racial/ethnic group

	OR no prenatal care/First Trimester care (95% Confidence Interval), SIDS	OR Third Trimester prenatal care/First Trimester care (95% Confidence Interval), SIDS	OR no prenatal care/First Trimester care (95% Confidence Interval), SUID	OR Third Trimester prenatal care/First Trimester care (95% Confidence Interval), SUID
Black	2.20 (1.80, 2.68)	1.58 (1.35, 1.85)	2.66 (2.36, 3.00)	1.65 (1.49, 1.82)
AI/AN	*1.36 (0.55, 3.34)*	*1.12 (0.65, 1.93)*	*1.59 (0.90, 2.79)*	*1.24 (0.87, 1.77)*
White	3.87 (3.24, 4.61)	2.49 (2.21, 2.81)	4.04 (3.57, 4.57)	2.60 (2.39, 2.83)
Hispanic	2.94 (2.23, 3.89)	0.67 (0.36, 0.54)	3.59 (3.01, 4.27)	2.01 (1.74, 2.33)
Asian/PI	2.88 (1.07, 7.81)	3.15 (2.02, 4.91)	4.43 (2.48, 7.92)	2.45 (1.72, 3.49)

Note. Black, AI/AN, White, and Asian/PI are all non-Hispanic. Numbers in italic indicate failure to reach statistical significance. AI/AN: American Indian/ Alaskan Native; OR: odds ratio; PI: Pacific Islander; SIDS: sudden infant death syndrome; SUID: sudden unexpected infant death. Source of prenatal care comes from (Centers for Disease Control and Prevention & National Center for Health Statistics, 2017 December).

Reference

Centers for Disease Control and Prevention, & National Center for Health Statistics. (2017 December). Underlying Cause of Death 1999-2016 on CDC WONDER Online Database. Retrieved from http://wonder.cdc.gov/ucd-icd10.html